HARDWARE REFERENCE MANUAL

Turbo PMAC2 PCI

Programmable Multi-Axis Controller

4xx-603367-xHxx

May 26, 2004

DELTA TAU
Data Systems, Inc.
NEW IDEAS IN MOTION ...

Single Source Machine Control *Power // Flexibility // Ease of Use*
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INTRODUCTION

The Turbo PMAC2 PCI (part number 400-603367-TRx) is a member of the Turbo PMAC family of boards optimized for interface to sinewave or direct-PWM servo drives and to pulse-and-direction stepper drives. Its software is capable of 32 axes of control. It can have up to eight channels of on-board axis interface circuitry. It can also support up to 32 channels of off-board axis interface circuitry through its expansion port, connected to Acc-24P or Acc-24P2 ISA-format boards (Acc-24 boards in PCI format are not yet available).

The Turbo PMAC2 PCI is a full-sized PCI-bus expansion card, with a small piggyback board containing the CPU board. This piggyback board occupies part of the next slot, but ½-sized boards are permitted in this next slot. While the Turbo PMAC2 PCI is capable of PCI bus communications, with or without the optional on-board dual-ported RAM, it does not need to be inserted into a PCI expansion slot.

Communications can be done through the standard RS-232/RS-422 serial port; standalone operation is possible.

Board Configuration

Base Version

The base version of the Turbo PMAC2 PCI provides a 1-1/2-slot board with:

- 80 MHz DSP56303 CPU (120 MHz PMAC equivalent)
- 128k x 24 SRAM compiled/assembled program memory (5C0)
- 128k x 24 SRAM user data memory (5C0)
- 1M x 8 flash memory for user backup and firmware (5C0)
- Latest released firmware version
- RS-232 serial interface, PCI (PC) bus interface
- One 16-node MACRO interface IC
- Four channels axis interface circuitry, each including:
  - Three output command signal sets, configurable as either:
    - Two serial data streams to external DACs, one pulse-and-direction
    - Three PWM top-and-bottom pairs
- 3-channel differential/single-ended encoder input
- Nine input flags, two output flags
- Interface to two external serial ADCs, 8 to 18 bits
- Two channels supplemental interface circuitry, each including:
- 2-channel differential/single-ended encoder input
- One output command signal set, configurable as pulse-&-direction or PWM top-and-bottom pair
- Display, MACRO, muxed I/O, direct I/O interface ports
- PID/notch/feedforward servo algorithms
- Extended pole-placement servo algorithms
- 1-year warranty from date of shipment
- One manual per set of one to four PMACs in shipment (Cables, mounting plates, mating connectors not included)

Option 1: Additional Four Channels Axis Interface Circuitry

Option 1 provides an additional four channels of on-board axis interface circuitry, identical to the standard first four channels. The key components are the DSPGATE1 IC at U7 and connectors J11 and J12.

Option 2: Dual-Ported RAM

Dual-ported RAM provides a high-speed communications path for bus communications with the host computer through a bank of shared memory. DPRAM is advised if more than about 100 data items per second are to be passed between the controller and the host computer in either direction.

Option 2 provides a 32k x 16 bank of dual-ported RAM. The key component on the board is U92.

Option 5: CPU and Memory Configurations

The various versions of Option 5 provide different CPU speeds and main memory sizes on the piggyback CPU board. Only one Option 5xx may be selected for the board.

The CPU is a DSP5630x IC as component U1. It is currently available only as an 80 MHz device (with computational power equivalent to a 120 MHz non-Turbo PMAC), but higher speed versions will be available shortly.

The compiled/assembled-program memory SRAM ICs are located in U14, U15, and U16. These ICs form the active memory for the firmware, compiled PLCs, and user-written phase/servo algorithms.

These can be 128k x 8 ICs (for a 128k x 24 bank), fitting in the smaller footprint, or they can be the larger 512k x 8 ICs (for a 512k x 24 bank), fitting in the full footprint.

The user-data memory SRAM ICs are located in U11, U12, and U13. These ICs form the active memory for user motion programs, uncompiled PLC programs, and user tables and buffers. These can be 128k x 8 ICs (for a 128k x 24 bank), fitting in the smaller footprint, or they can be the larger 512k x 8 ICs (for a 512k x 24 bank), fitting in the full footprint.

The flash memory IC is located in U10. This IC forms the non-volatile memory for the board's firmware, the user setup variables, and for user programs, tables, and buffers. It can be 1M x 8, 2M x 8, or 4M x 8 in capacity.

- Option 4C provides an 80 MHz DSP56309 CPU with expanded internal memory to improve performance for large number of commutated axes.
- Option 5C0 is the standard CPU and memory configuration. It is provided automatically if no Option 5xx is specified. It provides an 80 MHz CPU (120 MHz PMAC equivalent), 128k x24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option 5C1 provides an 80 MHz CPU (120 MHz PMAC equivalent), 128k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 2M x 8 flash memory.
- Option 5C2 provides an 80 MHz CPU (120 MHz PMAC equivalent), an expanded 512k x 24 of compiled/assembled program memory, 128k x 24 of user data memory, and a 2M x 8 flash memory.
- Option 5C3 provides an 80 MHz CPU (120 MHz PMAC equivalent), an expanded 512k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 4M x 8 flash memory.
- Option 5D0 provides a 100 MHz CPU (120 MHz PMAC equivalent), 128k x24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory. It is not compatible with Option-4C.
- Option 5D1 provides a 100 MHz CPU (120 MHz PMAC equivalent), 128k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 2M x 8 flash memory. Check with the factory for availability.
- Option 5D2 provides a 100 MHz CPU (120 MHz PMAC equivalent), an expanded 512k x 24 of compiled/assembled program memory, 128k x 24 of user data memory, and a 2M x 8 flash memory. Check with the factory for availability.
- Option 5D3 provides a 100 MHz CPU (120 MHz PMAC equivalent), an expanded 512k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 4M x 8 flash memory. Check with the factory for availability.

Option 7: Plate Mounting

Option 7 provides a mounting plate connected to the Turbo PMAC2 PCI with standoffs. It is used to install the Turbo PMAC2 PCI in standalone applications.

Option 8: High-Accuracy Clock Crystal

The Turbo PMAC2 PCI has a clock crystal (component Y1) of nominal frequency 19.6608 MHz (~20 MHz). The standard crystal's accuracy specification is +/-100 ppm.

- Option 8A provides a nominal 19.6608 MHz crystal with a +/-15 ppm accuracy specification.

Option 9: Serial Port Configuration

The Turbo PMAC2 PCI comes standard with a single serial port that can use either RS-232 or RS-422 transceivers. Optionally, a second independent serial port can be added.

- Option 9T adds an auxiliary RS-232 port on the CPU piggyback board. The key components added are IC U22 and connector J8 on the CPU board.

Option 10: Firmware Version Specification

Normally the Turbo PMAC2 PCI is provided with the newest released firmware version. A label on the U10 flash memory IC on the CPU board shows the firmware version loaded at the factory.

- Option 10 provides for a user-specified firmware version.

Option 12: Analog-to-Digital Converters

Option 12 permits the installation of 8 or 16 channels of on-board multiplexed analog-to-digital converters. One or two of these converters are read every phase interrupt. The analog inputs are not optically isolated, and each can have a 0 – 5V input range, or a +/-2.5V input range, individually selectable.

- Option 12 provides an 8-channel 12-bit A/D converter. The key components on the board are U28 and connector J1.
- Option 12A provides an additional 8-channel 12-bit A/D converter. The key component on the board is U29.

Option 16: Battery-Backed Parameter Memory

The contents of the standard memory are not retained through a power-down or reset unless they have been saved to flash memory first. Option 16 provides supplemental battery-backed RAM for real-time parameter storage that is ideal for holding machine state parameters in case of an unexpected powerdown. The battery is located at component BT1.

- Option 16A provides a 32k x 24 bank of battery-backed parameter RAM in components U17, U18, and U19 on the CPU board, fitting in the smaller footprint for those locations.
- Option 16B provides a 128k x 24 bank of battery-backed parameter RAM in components U17, U18, and U19 on the CPU board, filling the full footprint for those locations.

Option 18: Identification Number and Real Time Clock/Calendar Module

Option 18 provides a module at location U5 on the CPU board that contains an electronic identification number, and possibly a real-time clock/calendar.

- Option 18A provides an electronic identification number module.
- Option 18B provides an electronic identification number module with a real-time clock and calendar.

The year representation in the calendar is a 4-digit value, so there are no Year 2000 problems.

HARDWARE SETUP

Piggyback Turbo CPU Board Jumper Configuration

Watchdog Timer Jumper

Jumper E1 on the Turbo CPU board must be OFF for the watchdog timer to operate. This is a very important safety feature, so it is vital that this jumper be OFF in normal operation. E1 should only be put ON to debug problems with the watchdog timer circuit.

Dual-Ported RAM Source Jumper

On Turbo CPU boards with revision suffixes – 10A and newer, jumper E2 must connect pins 1 and 2 to access dual-ported RAM (addresses $06xxxx) from the baseboard. If using the Option 2 DPRAM on the baseboard, jumper E2 must be in this setting.

Jumper E2 must connect pins 2 and 3 to access dual-ported RAM (addresses $06xxxx) through the JEXP expansion port. If using the DPRAM on an external accessory board, jumper E2 must be in this setting.

On Turbo CPU boards with revision suffixes – 109 and older, there is no jumper for this purpose, and the boards can access DPRAM from either source, but with less robust buffering.

Power-Up State Jumpers

Jumper E4 on the Turbo CPU board must be OFF, jumper E5 must be ON, and jumper E6 must be ON in order for the CPU to copy the firmware from flash memory into active RAM on power-up/reset. This is necessary for normal operation of the card. (Other settings are for factory use only.)

Firmware Load Jumper

If jumper E7 on the CPU board is ON during power-up/reset, the board comes up in bootstrap mode, which permits the loading of new firmware into the flash-memory IC on the board. When the PMAC Executive program tries to establish communications with a board in this mode, it will detect that the board is in bootstrap mode automatically and ask what file to download as the new firmware.

Jumper E7 must be OFF during power-up/reset for the board to come up in normal operational mode.

Base Board Jumper Configuration

Servo and Phase Clock Direction Control

Jumper E1 should be OFF if the board is to use its own internally generated phase and servo clock signals. In this case, these signals are output on spare pins on the J5A RS-422 serial-port connector, where they can be used by other PMAC controllers set up to take external phase and servo clock signals. Jumper E1 should be ON if the board is to use externally generated phase and servo clock signals brought in on the J5A RS-422 serial port connector. In this case, the clock signals are generated by another PMAC controller and output on its serial port connector. Commonly, serial communications are also shared over a multi-drop RS-422 cable, with software addressing of the cards matching the I0 serial card number for each controller. Alternately, the phase and servo clock signals can come from clock signals involved in the process.

If E1 is ON for external phase and clock signals, and these clock signals are not brought in on the serial port connector, the watchdog timer will trip almost immediately and shut down the board.

In order to change the state of the card between use of internal clock and use of external clock, the card must be re-initialized – either powered up with jumper E3 ON, or given the **$$$***** command – with jumper E1 in the new state. Before the card is reset again, a **SAVE** command must be issued to store the new internal settings.

Re-Initialization Jumper

If E3 is OFF during power-up/reset, the controller will load its last saved set-up parameters from flash memory into active memory. T his is the setting for normal operation. If E3 is ON during power-up/reset, the controller will load its factory-default set-up parameters from firmware into active memory. Generally this is only done if communications cannot be established with the card when in comes up in normal operational mode.

Encoder Sample Clock Source Jumpers

Jumpers E13 and E14 control the source of the SCLK encoder-sampling clock for each servo IC. The default setting of no jumper installed means that the SCLK signal comes from the servo IC and is output on the JMACH connectors. This setting is suitable for all but a few very special applications.

Serial Port Selection Jumper

Jumpers E17 and E18 control which serial-port connector is used. If E17 and E18 connect their pins 1 and 2, the 10-pin RS-232 port connector J5 is used. If E17 and E18 connect their pins 2 and 3, the 26-pin RS-422 port connector J5A is used. The RS-422 port must be used if several cards are to be daisy chained together on a single multi-drop cable.

Output Disable State Jumpers

Jumpers E111 through E118 control the hardware state of the digital command output signals for each channel when the amplifier enable signal for that channel is in the disable state (false). Jumper E11n (n = 1 to 8) controls the output signals for Channel n on the board.

If E11n is OFF (default), the command output signals for Channel n are still active when the amplifier enable signal is in the disable state. The Turbo PMAC software should be commanding a net zero command to be output on these signals and the amplifier-enable signal should be used by the amplifier so that no command output will cause action if it is receiving a disable signal. This OFF setting should be definitely be used when DAC output format is selected for the channel.

If E11n is ON, the command output signals for Channel n are tri-stated when the amplifier-enable signal is in the disable state. Typically, this setting is only used with direct-PWM power-block amplifiers that do not use amplifier enable to gate the PWM signals and in which the zero-command format of 50% top on-time, and 50% bottom on-time cannot be tolerated in the disable state.

Resistor Pack Configuration

Termination Resistors

The PMAC2 PCI provides sockets for termination resistors on differential input pairs coming into the board. As shipped, there are no resistor packs in these sockets. If these signals are brought long distances into the PMAC2 PCI board and ringing at signal transitions is a problem, SIP resistor packs may be mounted in these sockets to reduce or eliminate the ringing.

All termination resistor packs are the type that has independent resistors (no common connection) with each resistor using two adjacent pins. The following table shows which packs are used to terminate each input device:

Input	Pack	Pack Size	Input	Pack	Pack Size
Encoder 1	RP46	6-pin	ADC 1 and 2	RP60	8-pin
Encoder 2	RP50	6-pin	ADC 3 and 4	RP61	8-pin
Encoder 3	RP47	6-pin	ADC 5 and 6	RP121	8-pin
Encoder 4	RP51	6-pin	ADC 7 and 8	RP122	8-pin
Encoder 5	RP107	6-pin	Fault 1 and 2	RP63	6-pin
Encoder 6	RP111	6-pin	Fault 3 and 4	RP64	6-pin
Encoder 7	RP108	6-pin	Fault 5 and 6	RP124	6-pin
Encoder 8	RP112	6-pin	Fault 7 and 8	RP125	6-pin
SCLK12 and 34	RP52	6-pin	SCLK56 and 78	RP113	6-pin

Pull-Up/Pull-Down Resistors

The differential input signal pairs to the PMAC2 PCI have user-configurable pull-up/pull-down resistor networks to permit the acceptance of either single-ended or differential signals in one setting, or the detection of lost differential signals in another setting.

The '+' inputs of each differential pair each have a hard-wired 1 kohm pull-up resistor to +5V. This cannot be changed.

The '-' inputs of each differential pair each have a hard-wired 2.2 kohm resistor to +5V; each also has another 2.2 kohm resistor as part of a socketed resistor pack that can be configured as a pull-up resistor to +5V, or a pull-down resistor to GND.

If this socketed resistor is configured as a pull-down resistor (the default configuration), the combination of pull-up and pull-down resistors on this line acts as a voltage divider, holding the line at +2.5V in the absence of an external signal. This configuration is required for single-ended inputs using the '+' lines alone; it is desirable for unconnected inputs to prevent the pick-up of spurious noise; it is permissible for differential line-driver inputs.

If this socketed resistor is configured as a pull-up resistor (by reversing the SIP pack in the socket), thetwo parallel 2.2 kohm resistors act as a single 1.1 kohm pull-up resistor, holding the line at +5V in the absence of an external signal. This configuration is required if encoder-loss detection is desired; it is required if complementary open-collector drivers are used; it is permissible for differential line-driver inputs even without encoder loss detection.

If Pin 1 of the resistor pack, marked by a dot on the pack, matches Pin 1 of the socket, marked by a wide white line on the front side of the board, and a square solder pin on the back side of the board, then the pack is configured as a bank of pull-down resistors. If the pack is reversed in the socket, it is configured as a bank of pull-up resistors.

The following table lists the pull-up/pull-down resistor pack for each input device:

Device	Resistor Pack	Device	Resistor Pack
Encoder 1	RP43	ADC/Fault1&2	RP58
Encoder 2	RP48	ADC/Fault3&4	RP59
Encoder 3	RP44	ADC/Fault5&6	RP119
Encoder 4	RP49	ADC/Fault7&8	RP120
Encoder 5	RP104	SCLK12&34	RP62
Encoder 6	RP109	SCLK56&78	RP123
Encoder 7	RP105		
Encoder 8	RP110		

Connections

Mounting

The Turbo PMAC2 PCI can be mounted in one of two ways: in the PCI bus, or using standoffs.

- PCI bus: To mount in the PCI bus, simply insert the P1 card-edge connector into PCI socket. If there is a standard PC-style housing, a bracket at the end of the PMAC2 PCI board can be used to screw into the housing to hold the board down firmly.
- Standoffs: At each of the four corners of the PMAC2 PCI board, there are mounting holes that can be used to mount the board on standoffs.

Power Supply Connection

The standard PMAC2 PCI requires only 5V power: 3A in a 4-channel configuration, 4A in an 8-channel configuration (with Option 1). If the Option 12 A/D converters are installed, a –12V supply is also required. In this case, a +12V supply can be passed through the card and out to the analog devices feeding the A/D converters.

The power can be provided in several ways:

- Bus connector: If the PMAC2 PCI is mounted in an electrically active PCI bus slot, it automatically draws its 5V and +/-12V power from the bus.
- Terminal block: The TB1 2/4-point terminal block can be used to bring in 5V power, especially in standalone applications. Point 1 is GND; Point 2 is +5V. Points 3 (+12V) and 4 (-12V) are needed only if the Option 12 A/D converters are ordered.
- JMACH connectors: Up to 2A at 5V may be brought in through each 100-pin JMACH connector from an Acc-8 board or its equivalent, provided the cable is 500 mm (20 in) or less in length.

Machine Port Connections

The Turbo PMAC2 PCI has a 100-pin high-density header for each pair of servo interface channels. Through this connector pass all of the digital signals to and from the amplifier, encoder, and flags for the two channels. Typically, this header is connected with a matching Delta Tau Acc-8 family 2-channel breakout board or equivalent through a provided 100-pin flat cable.

The machine port connectors are:

- J9 (JMACH1) Board Channels 1 and 2
- J10 (JMACH2) Board Channels 3 and 4
- J11 (JMACH3) Board Channels 5 and 6 (Option 1 required)
- J12 (JMACH4) Board Channels 7 and 8 (Option 1 required)

Display Port

The J6 (JDISP) display port provides a 14-pin IDC header for connection to Delta Tau's Acc-12 family of displays. Flat cables are provided with each of the Acc-12 displays for direct connection between the display and this port.

Multiplexer Port

The J2 (JTHW) multiplexer port provides eight TTL-compatible 5V CMOS inputs and eight TTL-compatible 5V CMOS outputs on a 26-pin IDC header. These can be used directly as general-purpose digital I/O, or with PMAC2's special M-variable support (TWB, TWD, TWR, and TWS formats) they can be used to support hundreds, or even thousands of multiplexed I/O points on accessory boards.

Delta Tau provides the following accessory boards that can be connected to the multiplexer port. Each comes with a flat cable for direct connection to the port.

- Acc-8D Option 7 Resolver-to-Digital Converter Board
- Acc-18 Thumbwheel Board
- Acc-34 family of Digital I/O boards
- Acc-35A and B Extender Board

I/O Port

The J3 (JIO) I/O port provides 32 TTL-compatible 5V CMOS I/O points on a 40-pin IDC header. Direction is selectable by byte. These are intended for use as general-purpose digital I/O points.

Serial Ports

The PMAC2 PCI has two serial-port connectors. Only one of these can be used in an application J5 is a 10-pin IDC header for RS-232 communications. It can be connected to a standard DB9 RS-232 connector on a host computer or terminal via a flat cable such as the Acc-3L. A commercially available DB9-to-DB25 adapter can be added to such a flat cable if the host computer or terminal has a DB25 serial connector. Jumpers E17 and E18 on the PMAC2 PCI must connect pins 1 and 2 to use this port.

J5A is 26-pin IDC header for RS-422 communications. It can be connected to a standard DB25 RS-422 connector on a host computer or terminal via a flat cable such as the Acc-3D. Jumpers E17 and E18 on the PMAC2 PCI must connect pins 2 and 3 to use this port.

A/D-Converter Port

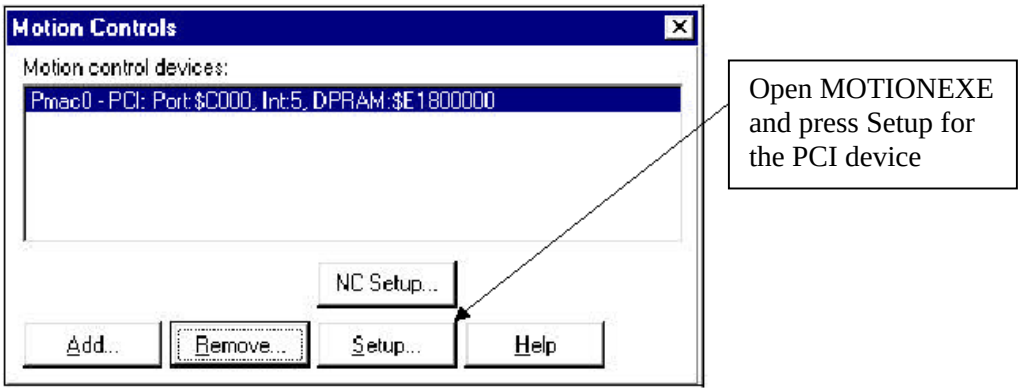
If the Option 12 A/D converters are ordered, the J1 (JANA) analog-input port is provided on the PMAC2 on a 20-pin IDC header. Option 12 provides eight analog inputs at 0 – 5V, or +/-2.5V levels. Option 12A provides eight additional analog inputs at these levels. The +12V and –12V supplies can either be brought in on this connector, or brought out on it for the external analog circuitry if they have been brought in through TB1 or P1.

Handwheel Port

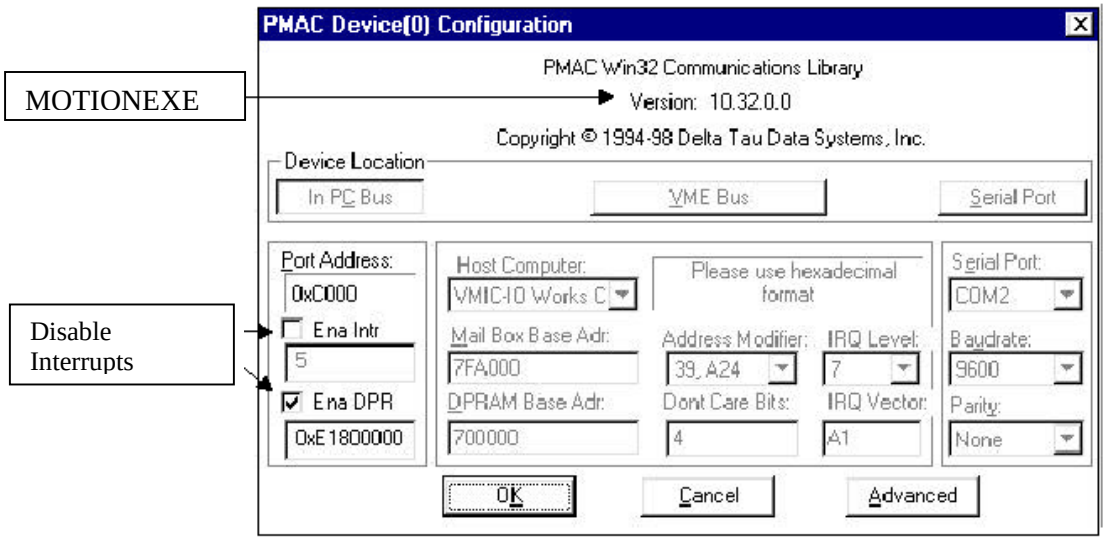
The J7 (JHW) handwheel port provides two limited supplemental channels, each with a 2-channel encoder input, and a pulse-and-direction or PWM top-and-bottom pair output. All inputs and outputs are digital 5V differential line-driver pairs.

COMMUNICATIONS SETUP

Delta Tau provides communication tools that take advantage of the PCI bus Plug and Play feature of 32-bits Windows© based computers. Starting with MOTIONEXE.EXE version 10.32.00, which is included in Pewin 32 version 2.32 and newer, a PMAC2 PCI board plugged in a PCI bus slot will be recognized by the operating system when the computer is boot up. The available PCI address, dual-ported RAM address and Interrupt lines are set automatically by the operating system and can be checked (but not modified) in the MOTIONEXE.EXE application.



The PMAC2 PCI board could have the optional on-board Dual Ported RAM circuitry, which is ordered through Option 2. If the dual-ported RAM circuitry is not on-board, manually disable the automatically assigned use through the setup page of MOTIONEXE:



The MOTIONEXE application will first look for PMAC PCI boards on the PCI bus and will sequentially assign device numbers from Device0 to each PMAC PCI until all the PMAC PCI boards found have a device number assigned. Then, manually add other devices for either ISA bus or Serial port communications.

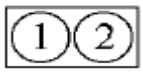
After each PMAC has a device number assigned to it, communications through the PCI bus are identical to the ISA bus. Any application written for the ISA bus using the Delta Tau provided 32-bits communication libraries will not require any further change and the process is transparent.

Note:

For example, if a Device0 for serial RS-232 communications was defined before a PMAC PCI board was installed in the computer, its setup information will be overwritten by the MOTIONEXE application when the PMAC2 PCI board is found. Therefore, it is very important to take note of the all the devices and its parameters defined in MOTIONEXE before installing a new PMAC board in the computer.

CPU BOARD E-POINT DESCRIPTIONS

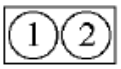
E1: Watchdog Disable Jumper

E Point and Physical Layout	Description	Default
E1 	Jump pin 1 to 2 to disable Watchdog timer (for test purposes only). Remove jumper to enable Watchdog timer.	No jumper installed

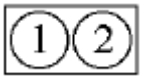
E2: DPRAM Location Configure

E Point and Physical Layout	Description	Default
E2 	Jump pin 1 to 2 to access the dual-ported RAM on baseboard. Jump pin 2 to 3 to access the dual-ported RAM through JEXP expansion port.	Jumper connects pins 1 and 2
Note: Jumper E2 is present on –108 and newer boards only. Older versions could access DPRAM from either source without a jumper configuration, but with less robust buffering.		

E4 – E6: Power-Up/Reset Load Source

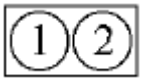
E Point and Physical Layout	Description	Default
E4  **E6**	Remove jumper E4; Jump E5 pin 1 to 2; Jump E6 pin 1 to 2; To read flash IC on power-up/reset. Other combinations are for factory use only; the board will not operate in any other configuration	No E4 jumper installed; E5 and E6 jump pin 1 to 2.

E7: Firmware Reload Enable

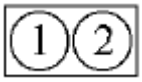
E Point and Physical Layout	Description	Default
E7 	Jump pin 1 to 2 to reload firmware through serial or bus port. Remove jumper for normal operation.	No jumper installed

BASE BOARD JUMPER DESCRIPTIONS

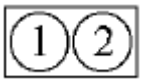
E1: Servo and Phase Clock Direction Control

E Point and Physical Layout	Location	Description	Default
E1 	C2	Remove jumper for PMAC2 PCI to use its internally generated servo and phase clock signals and to output these signals on the J5A serial port connector. Jump pins 1 and 2 for PMAC2 PCI to expect to receive its servo and phase clock signals on the J5A serial port connector.	No jumper installed
Note: If the E1 jumper is ON and the servo and phase clocks are not brought in on the J5A serial port, the watchdog timer will trip immediately.			

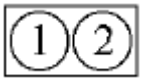
E2: CPU Frequency Select

E Point and Physical Layout	Location	Description	Default
E2 	C2	Remove jumper for 40 MHz operation (E4 OFF also) or for 80 MHz operation (E4 ON). Jump pin 1 to 2 for 60 MHz operation (E4 OFF).	No jumper installed (standard or Option 5C) Jumper installed (Option 5B)

E3: Normal/Re-Initializing Power-Up/Reset

E Point and Physical Layout	Location	Description	Default
E3 	C2	Jump pin 1 to 2 to re-initialize on power-up/reset, loading factory default settings. Remove jumper for normal power up/reset, loading user-saved settings.	No jumper installed

E4: CPU Frequency Select

E Point and Physical Layout	Location	Description	Default
E4 	C2	Remove jumper for 40MHz operation (E2 OFF also) or for 60MHz operation (E4 ON). Jump pin 1 to 2 for 80MHz operation (E2 OFF).	No jumper installed (standard or Option 5B) Jumper installed (Option 5C)

E5 – E6: (Reserved for Future Use)

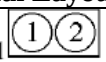
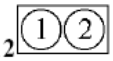
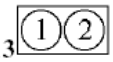
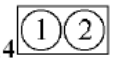
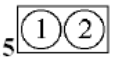
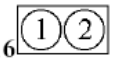
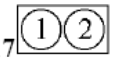
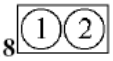
E13 - E14: Encoder Sample Clock Direction Control

E Point and Physical Layout	Location	Description	Default
E13	D1	Remove jumper to output SCLK generated in first ASIC on SCLK_12 and SCLK_34, or to control direction by software. Jump pins 1 to 2 to input SCLK signal for first ASIC on SCLK_34 and output this signal on SCLK_12. Jump pins 2 to 3 to input SCLK signal for first ASIC on SCLK_12 and output this signal on SCLK_34.	No jumper installed
E14	D2	Remove jumper to output SCLK generated in second ASIC on SCLK_56 and SCLK_78, or to control direction by software. Jump pins 1 to 2 to input SCLK signal for second ASIC on SCLK_78 and output this signal on SCLK_56. Jump pins 2 to 3 to input SCLK signal for second ASIC on SCLK_56 and output this signal on SCLK_78	No jumper installed
Note: E14 is installed only if Option 1 has been ordered.			

E17 - E18: Serial Port Type Selection

E Point and Physical Layout	Location	Description	Default
E17	C1	Connect pins 1 and 2 to use the RS-232 port on the J5 connector. Connect pins 2 and 3 to use the RS-422 port on the J5A connector.	Jumper installed in 1-2 position.
E18	C1	Connect pins 1 and 2 to use the RS-232 port on the J5 connector. Connect pins 2 and 3 to use the RS-422 port on the J5A connector.	Jumper installed in 1-2 position.
Serial Port Choice: Because both RS-232 and RS-422 ports are always provided, jumpers must be set correctly to use the port of your choice. Jumpers E17 and E18 must connect pins 1 and 2 to use the RS- 232 port on the J5 connector; they must connect pins 2 and 3 to use the RS-422 port on the J5A connector.			

E111-118: Command Output Disable State

E Point and Physical Layout	Location	Description	Default
E111  E112  E113  E114  E115  E116  E117  E118 	C1	Jump pin 1 to 2 of E11*n* for digital servo command output signals of Channel *n* to tri-state when amplifier enable signal for Channel *n* is in disable state. Remove jumper for digital servo command output signals of Channel *n* to remain active (but typically with zero command value) when amplifier enable signal for Channel *n* is in disable state.	No jumper installed

MATING CONNECTORS

CPU Board Connectors

J2 (JEXP)/Expansion

1. Two 50-pin female flat cable connector Delta Tau P/N 014-R00F50-0K0 T&B Ansley P/N 609-5041
2. 171-50 T&B Ansley standard flat cable stranded 50-wire
3. Phoenix varioface module type FLKM 50 (male pins) P/N 22 81 08 9

J8 (JAUX232)/Auxiliary RS232

1. Two 10-pin female flat cable connector Delta Tau P/N 014-ROOF10-0K0 T&B Ansley P/N 609-1041
2. 171-10 T&B Ansley standard flat cable stranded 10-wire
3. Phoenix varioface module type FLKM 10 (male pins) P/N 22 81 01 8

Base Board Connectors

J1 (JANA)/Analog (Option 12)

1. Two 14-pin female flat cable connector Delta Tau P/N 014-R00F14-0K0 T&B Ansley P/N 609-1441
2. 171-14 T&B Ansley standard flat cable stranded 14-wire
3. Phoenix varioface modules type FLKM14 (male pins) P/N 22 81 02 1

J2 (JTHW)/Multiplexer Port

1. Two 26-pin female flat cable connector Delta Tau P/N 014-R00F26-0K0 T&B Ansley P/N 609-2641
2. 171-26 T&B Ansley standard flat cable stranded 26-wire
3. Phoenix varioface module type FLKM 26 (male pins) P/N 22 81 05 0

J3 (JIO)/Digital I/O

1. Two 40-pin female flat cable connector Delta Tau P/N 014-R00F40-0K0 T&B Ansley P/N 609-4041
2. 171-40 T&B Ansley standard flat cable stranded 40-wire
3. Phoenix varioface module type FLKM 40 (male pins)

J5 (JRS232)/RS-232 Serial Communications

1. Two 10-pin female flat cable connector Delta Tau P/N 014-ROOF10-0K0 T&B Ansley P/N 609-1041
2. 171-10 T&B Ansley standard flat cable stranded 10-wire
3. Phoenix varioface module type FLKM 10 (male pins) P/N 22 81 01 8

J5A (JRS422)/RS-422 Serial Communications

1. Two 26-pin female flat cable connector Delta Tau P/N 014-R00F26-0K0 T&B Ansley P/N 609-2641
2. 171-26 T&B Ansley standard flat cable stranded 26-wire
3. Phoenix varioface module type FLKM 26 (male pins) P/N 22 81 05 0

J6 (JDISP)/Display

1. Two 14-pin female flat cable connector Delta Tau P/N 014-R00F14-0K0 T&B Ansley P/N 609-1441
2. 171-14 T&B Ansley standard flat cable stranded 14-wire
3. Phoenix varioface modules type FLKM14 (male pins) P/N 22 81 02 1

J7 (JHW)/Auxiliary Channel

1. Two 20-pin female flat cable connector Delta Tau P/N 014-R00F20-0K0 T&B Ansley P/N 609-2041
2. 171-20 T&B Ansley standard flat cable stranded 20-wire
3. Phoenix varioface modules type FLKM20 (male pins)

J8 (JEQU)/Position Compare

1. Two 10-pin female flat cable connector Delta Tau P/N 014-ROOF10-0K0 T&B Ansley P/N 609-1041
2. 171-10 T&B Ansley standard flat cable stranded 10-wire
3. Phoenix varioface module type FLKM 10 (male pins) P/N 22 81 01 8

J9 (JMACH1)/Machine Port 1

1. Two 100-pin high-density box header with center key, 0.050” pitch, AMP P/N 1-04068-7, Delta Tau P/N 014-00010-FPB
2. High-density flat cable stranded 100-wire

J10 (JMACH2)/Machine Port 2

1. Two 100-pin high-density box header with center key, 0.050” pitch, AMP P/N 1-04068-7, Delta Tau P/N 014- 00010-FPB
2. High-density flat cable stranded 100-wire

J11 (JMACH3)/Machine Port 3

1. Two 100-pin high-density box header with center key, 0.050” pitch, AMP P/N 1-04068-7, Delta Tau P/N 014-00010-FPB
2. High-density flat cable stranded 100-wire

J12 (JMACH4)/Machine Port 4

1. Two 100-pin high-density box header with center key, 0.050” pitch, AMP P/N 1-04068-7, Delta Tau P/N 014-00010-FPB
2. High-density flat cable stranded 100-wire

CPU BOARD CONNECTOR PINOUTS

J8 (JAUX232)/Auxiliary Serial Port

Pin #	Symbol	Function	Description	Notes
1				No connect
2	DTR	Bidirectional	Data terminal ready	Tied to DRR
3	TXD/	Input	Receive data	Host transmit data
4	CTS	Input	Clear to Send	Host ready bit
5	RXD/	Output	Send data	Host receive data
6	RTS	Output	Request to Send	PMAC ready bit
7	DSR	Bidirectional	Data set ready	Tied to DTR
8				No connect
9	GND	Common	PMAC common	
10	+5V	Output	10 +5Vdc supply	Power supply out
The J8 connector on the Turbo CPU piggyback board, present if Option-9T has been ordered, provides a second independent port for serial communications at RS-232 levels.				

BASEBOARD CONNECTOR PINOUTS

J1 (JANA) Analog Input Port Connector

(Present only if Option 12 ordered)

Pin #	Symbol	Function	Description	Notes
1	ANAI00	Input	Analog Input 0	0-5V or +/-2.5V range
2	ANAI01	Input	Analog Input 1	0-5V or +/-2.5V range
3	ANAI02	Input	Analog Input 2	0-5V or +/-2.5V range
4	ANAI03	Input	Analog Input 3	0-5V or +/-2.5V range
5	ANAI04	Input	Analog Input 4	0-5V or +/-2.5V range
6	ANAI05	Input	Analog Input 5	0-5V or +/-2.5V range
7	ANAI06	Input	Analog Input 6	0-5V or +/-2.5V range
8	ANAI07	Input	Analog Input 7	0-5V or +/-2.5V range
9	ANAI08	Input	Analog Input 8	0-5V or +/-2.5V range*
10	ANAI09	Input	Analog Input 9	0-5V or +/-2.5V range*
11	ANAI10	Input	Analog Input 10	0-5V or +/-2.5V range*
12	ANAI11	Input	Analog Input 11	0-5V or +/-2.5V range*
13	ANAI12	Input	Analog Input 12	0-5V or +/-2.5V range*
14	ANAI13	Input	Analog Input 13	0-5V or +/-2.5V range*
15	ANAI14	Input	Analog Input 14	0-5V or +/-2.5V range*
16	ANAI15	Input	Analog Input 15	0-5V or +/-2.5V range*
17	GND	Common	PMAC common	Not isolated from digital
18	+12V	Output	Positive supply voltage	To power external circuitry
19	GND	Common	PMAC common	Not isolated from digital
20	-12V	Output	Negative supply voltage	To power external circuitry
The JANA connector provides the inputs for the 8 or 16 optional analog inputs on the PMAC2. * Only present if Option-12A ordered				

J2 (JTHW) Multiplexer Port Connector

Pin #	Symbol	Function	Description	Notes
1	GND	Common	PMAC common	
2	GND	Common	PMAC common	
3	DAT0	Input	Data-0 input	Data input from MUX port accessories
4	SEL0	Output	Select-0 output	Address/Data output for MUX port accessories
5	DAT1	Input	Data-1 input	Data input from MUX port accessories
6	SEL1	Output	Select-1 output	Address/Data output for MUX port accessories
7	DAT2	Input	Data-2 input	Data input from MUX port accessories
8	SEL2	Output	Select-2 output	Address/Data output for MUX port accessories
9	DAT3	Input	Data-3 input	Data input from MUX port accessories
10	SEL3	Output	Select-3 output	Address/Data output for MUX port accessories
11	DAT4	Input	Data-4 input	Data input from MUX port accessories
12	SEL4	Output	Select-4 output	Address/Data output for MUX port accessories
13	DAT5	Input	Data-5 input	Data input from MUX port accessories
14	SEL5	Output	Select-5 output	Address/Data output for MUX port accessories
15	DAT6	Input	Data-6 input	Data input from MUX port accessories
16	SEL6	Output	Select-6 output	Address/Data output for MUX port accessories
17	DAT7	Input	Data-7 input	Data input from MUX port accessories
18	SEL7	Output	Select-7 output	Address/Data output for MUX port accessories
19	NC	NC	NC	
20	GND	Common	PMAC common	
21	BRLD/	Output	Buffer request	Low is buffer required
22	GND	Common	PMAC common	
23	IPLD/	Output	In Position	Low is in position
24	GND	Common	PMAC common	
25	+5V	Output	+5Vdc supply	Power supply out
26	INIT/	Input	PMAC reset	Low is reset

J3 (JI/O) General Input/Output Connector

Pin #	Symbol	Function	Description	Notes
1	I/O00	In/Out	Digital I/O 0	Software direction control
2	I/O01	In/Out	Digital I/O 1	Software direction control
3	I/O02	In/Out	Digital I/O 2	Software direction control
4	I/O03	In/Out	Digital I/O 3	Software direction control
5	I/O04	In/Out	Digital I/O 4	Software direction control
6	I/O05	In/Out	Digital I/O 5	Software direction control
7	I/O06	In/Out	Digital I/O 6	Software direction control
8	I/O07	In/Out	Digital I/O 7	Software direction control
9	I/O08	In/Out	Digital I/O 8	Software direction control
10	I/O09	In/Out	Digital I/O 9	Software direction control
11	I/O20	In/Out	Digital I/O 10	Software direction control
12	I/O11	In/Out	Digital I/O 11	Software direction control
13	I/O12	In/Out	Digital I/O 12	Software direction control
14	I/O13	In/Out	Digital I/O 13	Software direction control
15	I/O14	In/Out	Digital I/O 14	Software direction control
16	I/O15	In/Out	Digital I/O 15	Software direction control
17	I/O16	In/Out	Digital I/O 16	Software direction control
18	I/O17	In/Out	Digital I/O 17	Software direction control
19	I/O18	In/Out	Digital I/O 18	Software direction control

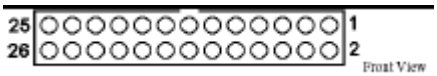
J3 (JI/O) General Input/Output Connector (Continued)

Pin #	Symbol	Function	Description	Notes
20	I/O19	In/Out	Digital I/O 19	Software direction control
21	I/O20	In/Out	Digital I/O 20	Software direction control
22	I/O21	In/Out	Digital I/O 21	Software direction control
23	I/O22	In/Out	Digital I/O 22	Software direction control
24	I/O23	In/Out	Digital I/O 23	Software direction control
25	I/O24	In/Out	Digital I/O 24	Software direction control
26	I/O25	In/Out	Digital I/O 25	Software direction control
27	I/O26	In/Out	Digital I/O 26	Software direction control
28	I/O27	In/Out	Digital I/O 27	Software direction control
29	I/O28	In/Out	Digital I/O 28	Software direction control
30	I/O29	In/Out	Digital I/O 29	Software direction control
31	I/O30	In/Out	Digital I/O 30	Software direction control
32	I/O31	In/Out	Digital I/O 31	Software direction control
33	GND	Common	Reference voltage	
34	GND	Common	Reference voltage	
35	Phase/	Output	Phase clock	For latching data
36	Servo/	Output	Servo clock	For latching data
37	GND	Common	Reference voltage	
38	GND	Common	Reference voltage	To power external circuitry
39	+5V	Output	Supply voltage	To power external circuitry
40	+5V	Output	Supply voltage	
The JI/O connector provides 32 input/output pins at TTL levels. Direction can be controlled in byte-wide groups.				

J5 (JRS232) Serial Port Connector

Pin #	Symbol	Function	Description	Notes
1	PHASE	Output	Phasing clock	
2	DTR	Bidirectional	Data terminal ready	Tied to DSR
3	TXD/	Input	Receive data	Host transmit data
4	DTS	Input	Clear to send	Host ready bit
5	RXD/	Output	Send data	Host receive data
6	RTS	Output	Request to send	PMAC ready bit
7	DSR	Bidirectional	Data set ready	Tied to DTR
8	SERVO	Output	Servo clock	
9	GND	Common	PMAC common	
10	+5V	Output	+5Vdc supply	Power supply out
The JRS232 connector provides the PMAC2-PC with the ability to communicate serially with an RS232 port. This connector cannot be used for daisy chain interconnection of multiple PMACs. The J5A RS-422 port must be used for daisy chaining. E17 and E18 must connect pins 1 and 2 to use the RS-232 port for serial communications.				

J5A: RS422 Serial Port Connector

JRS422 (26-Pin Connector)				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	CHASSI	Common	PMAC common	
2	S+5V	Output	+5Vdc supply	
3	RD-	Input	Receive data	Diff. I/O low true
4	RD+	Input	Receive data	Diff. I/O high true
5	SD-	Output	Send data	Diff. I/O low true
6	SD+	Output	Send data	Diff. I/O high true
7	CS+	Input	Clear to send	Diff. I/ O high true
8	CS-	Input	Clear to send	Diff. I/O low true
9	RS+	Output	Request to send	Diff. I/O high true
10	RS-	Output	Request to send	Diff. I/O low true
11	DTR	Bidirectional	Data terminal ready	Tied to DSR
12	INIT/	Input	PMAC reset	Low is reset
13	GND	Common	PMAC common	
14	DSR	Bidirectional	Data set ready	Tied to DDTR
15	SDIO-	Bidirectional	Special data	Diff. I/O low true
16	SDI0+	Bidirectional	Special data	Diff. I/O high true
17	SCIO-	Bidirectional	Special control	Diff. I/O low true
18	SCIO+	Bidirectional	Special control	Diff. I/O high true
19	SCK-	Bidirectional	Special clock	Diff. I/O low true
20	SCK+	Bidirectional	Special clock	Diff. I/O high true
21	SERVO-	Bidirectional	Servo clock	Diff. I/O low true
22	SERVO+	Bidirectional	Servo clock	Diff. I/O high true
23	PHASE-	Bidirectional	Phase clock	Diff. I/O low true
24	PHASE+	Bidirectional	Phase clock	Diff. I/O high true
25	GND	Common	PMAC common	
26	+5V	Output	+5Vdc supply	Power supply out
E17 and E18 must connect pins 2 and 3 to use the RS-422 port for serial communications. This connector could also be used to daisy chain interconnect multiple PMACs for synchronized operation.				

J6 (JDISP) Display Connector

Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	VDD	Output	+5V power	Power supply out
2	VSS	Common	PMAC common	
3	RS	Output	Read strobe	TTL signal out
4	VEE	Output	Contrast adjustment VEE	0 to +5Vdc*
5	E	Output	Display enable	High is enable
6	R/W	Output	Read or write	TTL signal out
7	DB1	Output	Display Data1	
8	DB0	Output	Display Data0	
9	DB3	Output	Display Data3	
10	DB2	Output	Display Data2	
11	DB5	Output	Display Data5	
12	DB4	Output	Display Data4	
13	DB7	Output	Display Data7	
14	DB6	Output	Display Data6	
The JDISP connector is used to drive the 2 lines x 24 character (Acc-12), 2 x 40 (Acc-12A) LCD, or the 2 x 40 vacuum fluorescent (Acc 12C) display unit. The Display command may be used to send messages and values to the display.				

J7 (JHW) Handwheel Encoder Connector

Pin #	Symbol	Function	Description	Notes
1	GND	Common	Reference voltage	
2	+5V	Output	Supply voltage	To power external circuitry
3	HWAL+	Input	HW positive A Channel	Also pulse input
4	HWAL-	Input	HW negative A Channel	Also pulse input
5	HWBL+	Input	HW negative B Channel	Also direction input
6	HWBL-	Input	HW negative B Channel	Also direction input
7	HWA2+	Input	HW positive A Channel	Also pulse input
8	HWA2-	Input	HW negative A Channel	Also pulse input
9	HWB2+	Input	HW positive B Channel	Also direction input
10	HWB2-	Output	HW negative B Channel	Also direction input
11	PUL1+	Output	PFM negative pulse	Also PWM bottom output
12	PUL1-	Output	PFM negative pulse	Also PWM bottom output
13	DIR1+	Output	PFM positive direction out	Also PWM top output
14	DIR1-	Output	PFM negative direction out	Also PWM top output
15	PUL2+	Output	PFM positive pulse	Also PWM bottom output
16	PUL2-	Output	PFM negative pulse	Also PWM bottom output
17	DIR2+	Output	PFM positive direction out	Also PWM top output
18	DIR2-	Output	PFM negative direction out	Also PWM top output
19	GND	Common	Reference voltage	
20	+5V	Output	Supply voltage	To power external circuitry

J8 (JEQU) Position Compare Output Connector

Pin #	Symbol	Function	Description	Notes
1	EQU1/	Output	Encoder 1 Comp - EQ	Programmed polarity
2	EQU2/	Output	Encoder 2 Comp – EQ	Programmed polarity
3	EQU3/	Output	Encoder 3 Comp – EQ	Programmed polarity
4	EQU4/	Output	Encoder 4 Comp – EQ	Programmed polarity
5	EQU5/	Output	Encoder 5 Comp – EQ	Programmed polarity
6	EQU6/	Output	Encoder 6 Comp – EQ	Programmed polarity
7	EQU7/	Output	Encoder 7 Comp – EQ	Programmed polarity
8	EQU8/	Output	Encoder 8 Comp – EQ	Programmed polarity
9	+V	Supply	Positive supply	+5V
10	GND	Common	Digital ground	
This connector provides the position-compare outputs for the eight encoder channels.				

J9 (JMACH1) Connector Description

J9 (JMACH1) Connector Description			99 | oooooooooo … oooooooooo | 1 100 | oooooooooo … oooooooooo | 2	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	+5V	Output/Input	+5V power	For external circuit or from external supply
2	+5V	Output/Input	+5V power	For external circuit or from external supply
3	GND	Common	Reference voltage	
4	GND	Common	Reference voltage	
5	CHA1+	Input	Encoder 1 positive A channel	Also pulse input
6	CHA1-	Input	Encoder 1 negative A channel	Also pulse input
7	CHB1+	Input	Encoder 1 positive B channel	Also direction input
8	CHB1-	Input	Encoder 1 negative B channel	Also direction input
9	CHC1+	Input	Encoder 1 positive C channel	Index channel
10	CHC1-	Input	Encoder 1 negative C channel	Index channel
11	CHU1	Input	Channel 1 U flag	Hall effect, fault code, or sub-count
12	CHV1	Input	Channel 1 V flag	Hall effect, fault code, or sub-count
13	CHW1	Input	Channel 1 W flag	Hall effect, fault code, or sub-count
14	CHT1	Input	Channel 1 T flag	Fault code or sub-count
15	USER1	Input	General purpose user flag	Hardware capture flag or sub-count
16	PLIM1	Input	Positive overtravel limit	Hardware capture flag
17	MLIM1	Input	Negative overtravel limit	Hardware capture flag
18	HOME1	Input	Home switch input	Hardware capture flag
19	ACCFLT1	Input	Accessory fault flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
21	SCLK12+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
22	SCLK12-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
23	ADC_CLK1+	Output	A/D converter clock	Programmable frequency
24	ADC_CLK1-	Output	A/D converter clock	Programmable frequency
25	ADC_STB1+	Output	A/D converter strobe	Programmable sequence
26	ADC_STB1-	Output	A/D converter strobe	Programmable sequence
27	ADC_DAA1+	Input	Channel A ADC serial data	MSB first
28	ADC_DAA1-	Input	Channel A ADC serial data	MSB first
29	ADC_DAB1+	Input	Channel B ADC serial data	MSB first
30	ADC_DAB1-	Input	Channel B ADC serial data	MSB first
31	AENA1+	Output	Amplifier enable	High is enable
32	AENA1-	Output	Amplifier enable	Low is enable
33	FAULT1+	Input	Amplifier fault	Programmable parity
34	FAULT1-	Input	Amplifier fault	Programmable parity

J9 (JMACH1) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
35	PWMATOP1+ DAC_CLK1+	Output	Phase A top CMD or DAC clock	Programmable function control
36	PWMATOP1- DAC_CLK1-	Output	Phase A top CMD or DAC clock	Programmable function control
37	PWMABOT1+ DAC1A+	Output	Phase A bottom CMD or DAC A serial Data	Programmable function control
38	PWMABOT1- DAC1A-	Output	Phase A bottom CMD or DAC A serial Data	Programmable function control
39	PWMBTOP1+ DAC_STB1+	Output	Phase B top CMD or DAC strobe	Programmable function control
40	PWMBTOP1- DAC_STB1-	Output	Phase B top CMD or DAC strobe	Programmable function control
41	PWMBBOT1+ DAC1B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
42	PWMBBOT1- DAC1B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
43	PWMCTOP1+ DIR1+	Output	Phase B top CMD or PFM direction	Programmable function control
44	PWMCTOP1- DIR1-	Output	Phase B top CMD or PFM direction	Programmable function control
45	PWMCBOT1+ PULSE1+	Output	Phase B bottom CMD or PFM pulse	Programmable function control
46	PWMCBOT1- PULSE1-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
47	GND	Common	Reference voltage	
48	GND	Common	Reference voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference voltage	
54	GND	Common	Reference voltage	
55	CHA2+	Input	Encoder 2 positive A Channel	Also pulse input
56	CHA2-	Input	Encoder 2 negative A Channel	Also pulse input
57	CHB2+	Input	Encoder 2 positive B Channel	Also direction input
58	CHB2-	Input	Encoder 2 negative B Channel	Also direction input
59	CHC2+	Input	Encoder 2 positive C Channel	Index channel
60	CHC2	Input	Encoder 2 negative C Channel	Index channel
61	CHU2	Input	Channel 2 U flag	Hall effect, fault code or sub-count
62	CHV2	Input	Channel 2 V flag	Hall effect, fault code or sub-count
63	CHW2	Input	Channel 2 W flag	Hall effect, fault code or sub-count
64	CHT2	Input	Channel 2 T flag	Hall effect, fault code or sub-count
65	USER2	Input	General purpose user flag	Hardware capture flag, or sub-count

J9 (JMACH1) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
66	PLIM2	Input	Positive overtravel limit	Hardware capture flag
67	MLIM2	Input	Negative overtravel limit	Hardware capture flag
68	HOME2	Input	Home switch input	Hardware capture flag
69	ACCFLT2	Input	Accessory fault flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
71	SCLK12+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
72	SCLK12-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
73	ADC_CLK2+	Output	A/D converter clock	Programmable frequency
74	ADC_CLK2-	Output	A/D converter clock	Programmable frequency
75	ADC_STB2+	Output	A/D converter strobe	Programmable sequence
76	ADC_STB2-	Output	A/D converter strobe	Programmable sequence
77	ADC_DAA2+	Input	Channel A ADC serial data	MSB first
78	ADC_DAA2-	Input	Channel A ADC serial data	MSB first
79	ADC_DAB2+	Input	Channel B ADC serial data	MSB first
80	ADC_DAB2-	Input	Channel B ADC serial data	MSB first
81	AENA2+	Output	Amplifier enable	High is enable
82	AENA2-	Output	Amplifier enable	Low is enable
83	FAULT2+	Input	Amplifier fault	Programmable polarity
84	FAULT2-	Input	Amplifier fault	Programmable polarity
85	PWMATOP2+ DAC_CLK2+	Output	Phase A top CMD. or DAC clock	Programmable function control
86	PWMATOP2- DAC_CLK2-	Output	Phase A top CMD. or DAC clock	Programmable function control
87	PWMABOT2+ DAC2A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
88	PWMABOT2- DAC2A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
89	PWMBTOP2+ DAC_STB2+	Output	Phase B top CMD or DAC strobe	Programmable function control
90	PWMBTOP2- DAC_STB2-	Output	Phase B top CMD or DAC strobe	Programmable function control
91	PWMBBOT2+ DAC2B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
92	PWMBBOT2- DAC2B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
93	PWMCTOP2+ DIR2+	Output	Phase B top CMD or PFM direction	Programmable function control
94	PWMCTOP2- DIR2-	Output	Phase B top CMD or PFM direction	Programmable function control
95	PWMCBOT2+ PULSE2+	Output	Phase B bottom CMD or PFM pulse	Programmable function control
96	PWMCBOT2- PULSE2-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
97	GND	Common	Reference voltage	

J9 (JMACH1) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
98	GND	Common	Reference voltage	
99	+5V	Output/Input	+5V power	For external circuit or from external supply
100	+5V	Output/Input	+5V power	For external circuit or from external supply
The JMACH1 connector provides the interface pins for channels 1 and 2. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board. Connector: 100-pin male box header with center key, 0050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00010-FPB.				

J10 (JMACH2) Connector Description

J10 (JMACH2)			99 | oooooooooo … oooooooooo | 1 100 | oooooooooo … oooooooooo | 2	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	+5V	Output/Input	+5V power	For external circuit or from external supply
2	+5V	Output/Input	+5V power	For external circuit or from external supply
3	GND	Common	Reference voltage	
4	GND	Common	Reference voltage	
5	CHA3+	Input	Encoder 3 positive A channel	Also pulse input
6	CHA3-	Input	Encoder 3 negative A channel	Also pulse input
7	CHB3+	Input	Encoder 3 positive B channel	Also direction input
8	CHB3-	Input	Encoder 3 negative B channel	Also direction input
9	CHC3+	Input	Encoder 3 positive C channel	Index channel
10	CHC3-	Input	Encoder 3 negative C channel	Index channel
11	CHU3	Input	Channel 3 U flag	Hall effect, fault code, or sub-count
12	CHV3	Input	Channel 3 V flag	Hall effect, fault code, or sub-count
13	CHW3	Input	Channel 3 W flag	Hall effect, fault code, or sub-count
14	CHT3	Input	Channel 3 T flag	Fault code or sub-count
15	USER3	Input	General purpose user flag	Hardware capture flag or sub-count
16	PLIM3	Input	Positive overtravel limit	Hardware capture flag
17	MLIM3	Input	Negative overtravel limit	Hardware capture flag
18	HOME3	Input	Home switch input	Hardware capture flag
19	ACCFLT3	Input	Accessory fault flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
21	SCLK34+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
22	SCLK34-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
23	ADC_CLK3+	Output	A/D converter clock	Programmable frequency
24	ADC_CLK3-	Output	A/D converter clock	Programmable frequency
25	ADC_STB3+	Output	A/D converter strobe	Programmable sequence
26	ADC_STB3-	Output	A/D converter strobe	Programmable sequence
27	ADC_DAA3+	Input	Channel A ADC serial data	MSB first

J10 (JMACH2) (Continued)

Pin #	Symbol	Function	Description	Notes
28	ADC_DAA3-	Input	Channel A ADC serial data	MSB first
29	ADC_DAB3+	Input	Channel B ADC serial data	MSB first
30	ADC_DAB3-	Input	Channel B ADC serial data	MSB first
31	AENA3+	Output	Amplifier enable	High is enable
32	AENA3-	Output	Amplifier enable	Low is enable
33	FAULT3+	Input	Amplifier fault	Programmable parity
34	FAULT3-	Input	Amplifier fault	Programmable parity
35	PWMATOP3+ DAC_CLK3+	Output	Phase A top CMD or DAC clock	Programmable function control
36	PWMATOP3- DAC_CLK3-	Output	Phase A top CMD or DAC clock	Programmable function control
37	PWMABOT3+ DAC3A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
38	PWMABOT3- DAC3A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
39	PWMBTOP3+ DAC_STB3+	Output	Phase B top CMD or DAC strobe	Programmable function control
40	PWMBTOP3- DAC_STB3-	Output	Phase B top CMD or DAC strobe	Programmable function control
41	PWMBBOT3+ DAC3B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
42	PWMBBOT3- DAC3B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
43	PWMCTOP3+ DIR3+	Output	Phase B top CMD or PFM direction	Programmable function control
44	PWMCTOP3- DIR3-	Output	Phase B top CMD. or PFM direction	Programmable function control
45	PWMCBOT3+ PULSE3+	Output	Phase B bottom CMD or PFM pulse	Programmable function control
46	PWMCBOT3- PULSE3-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
47	GND	Common	Reference voltage	
48	GND	Common	Reference voltage	
49	+5V	Output/Input	+5V power	For external circuit or from external supply
50	+5V	Output/Input	+5V power	For external circuit or from external supply
51	+5V	Output/Input	+5V power	For external circuit or from external supply
52	+5V	Output/Input	+5V power	For external circuit or from external supply
53	GND	Common	Reference voltage	
54	GND	Common	Reference voltage	
55	CHA4+	Input	Encoder 4 positive A Channel	Also pulse input
56	CHA4-	Input	Encoder 4 negative A Channel	Also pulse input
57	CHB4+	Input	Encoder 4 positive B Channel	Also direction input
58	CHB4-	Input	Encoder 4 negative B Channel	Also direction input
59	CHC4+	Input	Encoder 4 positive C Channel	Index channel
60	CHC4-	Input	Encoder 4 negative C Channel	Index channel

J10 (JMACH2) (Continued)

Pin #	Symbol	Function	Description	Notes
61	CHU4	Input	Channel 4 U flag	Hall effect, fault code or sub-count
62	CHV4	Input	Channel 4 V flag	Hall effect, fault code or sub-count
63	CHW4	Input	Channel 4 W flag	Hall effect, fault code or sub-count
64	CHT4	Input	Channel 4 T flag	Fault code or sub-count
65	USER4	Input	General purpose user flag	Hardware capture flag, or sub-count
66	PLIM4	Input	Positive overtravel limit	Hardware capture flag
67	MLIM4	Input	Negative overtravel limit	Hardware capture flag
68	HOME4	Input	Home switch input	Hardware capture flag
69	ACCFLT4	Input	Accessory fault flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
71	SCLK34+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
72	-SCLK34	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
73	ADC_CLK4+	Output	A/D converter clock	Programmable frequency
74	ADC_CLK4-	Output	A/D converter clock	Programmable frequency
75	ADC_STB4+	Output	A/D converter strobe	Programmable sequence
76	ADC_STB4-	Output	A/D converter strobe	Programmable sequence
77	ADC_DAA4+	Input	Channel A ADC serial data	MSB first
78	ADC_DAA4-	Input	Channel A ADC serial data	MSB first
79	ADC_DAB4+	Input	Channel B ADC serial data	MSB first
80	ADC_DAB4-	Input	Channel B ADC serial data	MSB first
81	AENA4+	Output	Amplifier enable	High is enable
82	AENA4-	Output	Amplifier enable	Low is enable
83	FAULT4+	Input	Amplifier fault	83 Programmable polarity
84	FAULT4-	Input	Amplifier fault	Programmable polarity
85	PWMATOP4+ DAC_CLK4+	Output	Phase A top CMD. or DAC clock	Programmable function control
86	PWMATOP4- DAC_CLK4-	Output	Phase A top CMD. or DAC clock	Programmable function control
87	PWMABOT4+ DAC4A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
88	PWMABOT4- DAC4A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
89	PWMBTOP4+ DAC_STB4+	Output	Phase B top CMD or DAC strobe	Programmable function control
90	PWMBTOP4- DAC_STB4-	Output	Phase B top CMD or DAC strobe	Programmable function control
91	PWMBBOT4+ DAC4B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
92	PWMBBOT4- DAC4B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
93	PWMCTOP4+ DIR4+	Output	Phase B top CMD or PFM direction	Programmable function control
94	PWMCTOP4- DIR4-	Output	Phase B top CMD or PFM direction	Programmable function control

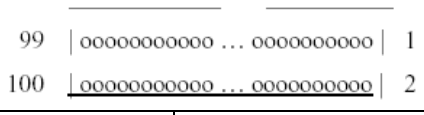
J10 (JMACH2) (Continued)

Pin #	Symbol	Function	Description	Notes
95	PWMCBOT4+ PULSE4+	Output	Phase B bottom CMD or PFM pulse	Programmable function control
96	PWMCBOT4- PULSE4-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
97	GND	Common	Reference voltage	
98	GND	Common	Reference voltage	
99	+5V	Output/Input	+5V power	For external circuit or from external supply
100	+5V	Output/Input	+5V power	For external circuit or from external supply
The JMACH1 connector provides the interface pins for channels 3 and 4. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board. Connector: 100-pin male box header with center key, 0050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00010-FPB.				

J11 (JMACH3)

This connector is present only if Option 1 was ordered.

J11 (JMACH3)



Pin #	Symbol	Function	Description	Notes
1	+5V	Output/Input	+5V power	For external circuit or from external supply
2	+5V	Output/Input	+5V power	For external circuit or from external supply
3	GND	Common	Reference voltage	
4	GND	Common	Reference voltage	
5	CHA5+	Input	Encoder 5 positive A channel	Also pulse input
6	CHA5-	Input	Encoder 5 negative A channel	Also pulse input
7	CHB5+	Input	Encoder 5 positive B channel	Also direction input
8	CHB5-	Input	Encoder 5 negative B channel	Also direction input
9	CHC5+	Input	Encoder 5 positive C channel	Index channel
10	CHC5-	Input	Encoder 5 negative C channel	Index channel
11	CHU5	Input	Channel 5 U flag	Hall effect, fault code, or sub-count
12	CHV5	Input	Channel 5 V flag	Hall effect, fault code, or sub-count
13	CHW5	Input	Channel 5 W flag	Hall effect, fault code, or sub-count
14	CHT5	Input	Channel 5 T flag	Fault code or sub-count
15	USER5	Input	General purpose user flag	Hardware capture flag or sub-count
16	PLIM5	Input	Positive overtravel limit	Hardware capture flag
17	MLIM5	Input	Negative overtravel limit	Hardware capture flag
18	HOME5	Input	Home switch input	Hardware capture flag
19	ACCFLT5	Input	Accessory fault flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
21	SCLK56+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
22	SCLK56-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper

J11 (JMACH3) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
23	ADC_CLK5+	Output	A/D converter clock	Programmable frequency
24	ADC_CLK5-	Output	A/D converter clock	Programmable frequency
25	ADC_STB5+	Output	A/D converter strobe	Programmable sequence
26	ADC_STB5-	Output	A/D converter strobe	Programmable sequence
27	ADC_DAA5+	Input	Channel A ADC serial data	MSB first
28	ADC_DAA5-	Input	Channel A ADC serial data	MSB first
29	ADC_DAB5+	Input	Channel B ADC serial data	MSB first
30	ADC_DAB5-	Input	Channel B ADC serial data	MSB first
31	AENA5+	Output	Amplifier enable	High is enable
32	AENA5-	Output	Amplifier enable	Low is enable
33	FAULT5+	Input	Amplifier fault	Programmable parity
34	FAULT5-	Input	Amplifier fault	Programmable parity
35	PWMATOP5+ DAC_CLK5+	Output	Phase A top CMD or DAC clock	Programmable function control
36	PWMATOP5- DAC_CLK5-	Output	Phase A top CMD or DAC clock	Programmable function control
37	PWMABOT5+ DAC5A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
38	PWMABOT5- DAC5A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
39	PWMBTOP5+ DAC_STB5+	Output	Phase B top CMD or DAC strobe	Programmable function control
40	PWMBTOP5- DAC_STB5-	Output	Phase B top CMD or DAC strobe	Programmable function control
41	PWMBBOT5+ DAC5B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
42	PWMBBOT5- DAC5B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
43	PWMCTOP5+ DIR5+	Output	Phase B top CMD or PFM direction	Programmable function control
44	PWMCTOP5- DIR5-	Output	Phase B top CMD. or PFM direction	Programmable function control
45	PWMCBOT5+ PULSE5+	Output	Phase B bottom CMD or PFM pulse	Programmable function control
46	PWMCBOT5- PULSE5-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
47	GND	Common	Reference voltage	
48	GND	Common	Reference voltage	
49	+5V	Output/Input	+5V power	For external circuit or from external supply
50	+5V	Output/Input	+5V power	For external circuit or from external supply
51	+5V	Output/Input	+5V power	For external circuit or from external supply
52	+5V	Output/Input	+5V power	For external circuit or from external supply
53	GND	Common	Reference voltage	
54	GND	Common	Reference voltage	
55	CHA6+	Input	Encoder 6 positive A Channel	Also pulse input
56	CHA6-	Input	Encoder 6 negative A Channel	Also pulse input
57	CHB6+	Input	Encoder 6 positive B Channel	Also direction input

J11 (JMACH3) (Continued)

Pin #	Symbol	Function	Description	Notes
58	CHB6-	Input	Encoder 6 negative B Channel	Also direction input
59	CHC6+	Input	Encoder 6 positive C Channel	Index channel
60	CHC6-	Input	Encoder 6 negative C Channel	Index channel
61	CHU6	Input	Channel 6 U flag	Hall effect, fault code or sub-count
62	CHV6	Input	Channel 6 V flag	Hall effect, fault code or sub-count
63	CHW6	Input	Channel 6 W flag	Hall effect, fault code or sub-count
64	CHT6	Input	Channel 6 T flag	Fault code or sub-count
65	USER6	Input	General purpose user flag	Hardware capture flag, or sub-count
66	PLIM6	Input	Positive overtravel limit	Hardware capture flag
67	MLIM6	Input	Negative overtravel limit	Hardware capture flag
68	HOME6	Input	Home switch input	Hardware capture flag
69	ACCFLT6	Input	Accessory fault flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
71	SCLK56+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
72	SCLK56-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
73	ADC_CLK6+	Output	A/D converter clock	Programmable frequency
74	ADC_CLK6-	Output	A/D converter clock	Programmable frequency
75	ADC_STB6+	Output	A/D converter strobe	Programmable sequence
76	ADC_STB6-	Output	A/D converter strobe	Programmable sequence
77	ADC_DAA6+	Input	Channel A ADC serial data	MSB first
78	ADC_DAA6-	Input	Channel A ADC serial data	MSB first
79	ADC_DAB6+	Input	Channel B ADC serial data	MSB first
80	ADC_DAB6-	Input	Channel B ADC serial data	MSB first
81	AENA6+	Output	Amplifier enable	High is enable
82	AENA6-	Output	Amplifier enable	Low is enable
83	FAULT6+	Input	Amplifier fault	Programmable polarity
84	FAULT6-	Input	Amplifier fault	Programmable polarity
85	PWMATOP6+ DAC_CLK6+	Output	Phase A top CMD. or DAC clock	Programmable function control
86	PWMATOP6- DAC_CLK6-	Output	Phase A top CMD. or DAC clock	Programmable function control
87	PWMABOT6+ DAC6A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
88	PWMABOT6- DAC6A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
89	PWMBTOP6+ DAC_STB6+	Output	Phase B top CMD or DAC strobe	Programmable function control
90	PWMBTOP6- DAC_STB6-	Output	Phase B top CMD or DAC strobe	Programmable function control
91	PWMBBOT6+ DAC6B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
92	PWMBBOT6- DAC6B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
93	PWMCTOP6+ DIR6+	Output	Phase B top CMD or PFM direction	Programmable function control
94	PWMCTOP6- DIR6-	Output	Phase B top CMD or PFM direction	Programmable function control
95	PWMCBOT6+ PULSE6+	Output	Phase B bottom CMD or PFM pulse	Programmable function control

J11 (JMACH3) (Continued)

Pin #	Symbol	Function	Description	Notes
96	PWMCBOT6- PULSE6-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
97	GND	Common	Reference voltage	
98	GND	Common	Reference voltage	
99	+5V	Output/Input	+5V power	For external circuit or from external supply
100	+5V	Output/Input	+5V power	For external circuit or from external supply
The JMACH1 connector provides the interface pins for channels 5 and 6. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board. Connector: 100-pin male box header with center key, 0050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00010-FPB.				

J12 (JMACH4)

(Only present if Option 1 ordered)

J12 (JMACH4)			99 | oooooooooo … oooooooooo | 1 100 | oooooooooo … oooooooooo | 2	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	+5V	Output/Input	+5V power	For external circuit or from external supply
2	+5V	Output/Input	+5V power	For external circuit or from external supply
3	GND	Common	Reference voltage	
4	GND	Common	Reference voltage	
5	CHA7+	Input	Encoder 7 positive A channel	Also pulse input
6	CHA7-	Input	Encoder 7 negative A channel	Also pulse input
7	CHB7+	Input	Encoder 7 positive B channel	Also direction input
8	CHB7-	Input	Encoder 7 negative B channel	Also direction input
9	CHC7+	Input	Encoder 7 positive C channel	Index channel
10	CHC7-	Input	Encoder 7 negative C channel	Index channel
11	CHU7	Input	Channel 7 U flag	Hall effect, fault code, or sub-count
12	CHV7	Input	Channel 7 V flag	Hall effect, fault code, or sub-count
13	CHW7	Input	Channel 7 W flag	Hall effect, fault code, or sub-count
14	CHT7	Input	Channel 7 T flag	Fault code or sub-count
15	USER7	Input	General purpose user flag	Hardware capture flag or sub-count
16	PLIM7	Input	Positive overtravel limit	Hardware capture flag
17	MLIM7	Input	Negative overtravel limit	Hardware capture flag
18	HOME7	Input	Home switch input	Hardware capture flag
19	ACCFLT7	Input	Accessory fault flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
21	SCLK78+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
22	SCLK78-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
23	ADC_CLK7+	Output	A/D converter clock	Programmable frequency
24	ADC_CLK7-	Output	A/D converter clock	Programmable frequency
25	ADC_STB7+	Output	A/D converter strobe	Programmable sequence
26	ADC_STB7-	Output	A/D converter strobe	Programmable sequence
27	ADC_DAA7+	Input	Channel A ADC serial data	MSB first

J12 (JMACH4) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
28	ADC_DAA7-	Input	Channel A ADC serial data	MSB first
29	ADC_DAB7+	Input	Channel B ADC serial data	MSB first
30	ADC_DAB7-	Input	Channel B ADC serial data	MSB first
31	AENA7+	Output	Amplifier enable	High is enable
32	AENA7-	Output	Amplifier enable	Low is enable
33	FAULT7+	Input	Amplifier fault	Programmable parity
34	FAULT7-	Input	Amplifier fault	Programmable parity
35	PWMATOP7+ DAC_CLK7+	Output	Phase A top CMD or DAC clock	Programmable function control
36	PWMATOP7- DAC_CLK7-	Output	Phase A top CMD or DAC clock	Programmable function control
37	PWMABOT7+ DAC7A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
38	PWMABOT7- DAC7A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
39	PWMBTOP7+ DAC_STB7+	Output	Phase B top CMD or DAC strobe	Programmable function control
40	PWMBTOP7- DAC_STB7-	Output	Phase B top CMD or DAC strobe	Programmable function control
41	PWMBBOT7+ DAC7B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
42	PWMBBOT7- DAC7B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
43	PWMCTOP7+ DIR7+	Output	Phase B top CMD or PFM direction	Programmable function control
44	PWMCTOP7- DIR7-	Output	Phase B top CMD. or PFM direction	Programmable function control
45	PWMCBOT7+ PULSE7+	Output	Phase B bottom CMD or PFM pulse	Programmable function control
46	PWMCBOT7- PULSE7-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
47	GND	Common	Reference voltage	
48	GND	Common	Reference voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference voltage	
54	GND	Common	Reference voltage	
55	CHA8+	Input	Encoder 8 positive A Channel	Also pulse input
56	CHA8-	Input	Encoder 8 negative A Channel	Also pulse input
57	CHB8+	Input	Encoder 8 positive B Channel	Also direction input
58	CHB8-	Input	Encoder 8 negative B Channel	Also direction input
59	CHC8+	Input	Encoder 8 positive C Channel	Index channel
60	CHC8	Input	Encoder 8 negative C Channel	Index channel
61	CHU8	Input	Channel 8 U flag	Hall effect, fault code or sub-count

J12 (JMACH4) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
62	CHV8	Input	Channel 8 V flag	Hall effect, fault code or sub-count
63	CHW8	Input	Channel 8 W flag	Hall effect, fault code or sub-count
64	CHT8	Input	Channel 8 T flag	Fault code or sub-count
65	USER8	Input	General purpose user flag	Hardware capture flag, or sub-count
66	PLIM8	Input	Positive overtravel limit	Hardware capture flag
67	MLIM8	Input	Negative overtravel limit	Hardware capture flag
68	HOME8	Input	Home switch input	Hardware capture flag
69	ACCFLT8	Input	Accessory fault flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog output	Low is PMAC watchdog fault
71	SCLK78+	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
72	SCLK78-	Input/Output	Encoder sample clock	Direction controlled by PMAC2 jumper
73	ADC_CLK8+	Output	A/D converter clock	Programmable frequency
74	ADC_CLK8-	Output	A/D converter clock	Programmable frequency
75	ADC_STB8+	Output	A/D converter strobe	Programmable sequence
76	ADC_STB8-	Output	A/D converter strobe	Programmable sequence
77	ADC_DAA8+	Input	Channel A ADC serial data	MSB first
78	ADC_DAA8-	Input	Channel A ADC serial data	MSB first
79	ADC_DAB8+	Input	Channel B ADC serial data	MSB first
80	ADC_DAB8-	Input	Channel B ADC serial data	MSB first
81	AENA8+	Output	Amplifier enable	High is enable
82	AENA8-	Output	Amplifier enable	Low is enable
83	FAULT8+	Input	Amplifier fault	Programmable polarity
84	FAULT8-	Input	Amplifier fault	Programmable polarity
85	PWMATOP8+ DAC_CLK8+	Output	Phase A top CMD. or DAC clock	Programmable function control
86	PWMATOP8- DAC_CLK8-	Output	Phase A top CMD. or DAC clock	Programmable function control
87	PWMABOT8+ DAC8A+	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
88	PWMABOT8- DAC8A-	Output	Phase A bottom CMD or DAC A serial data	Programmable function control
89	PWMBTOP8+ DAC_STB8+	Output	Phase B top CMD or DAC strobe	Programmable function control
90	PWMBTOP8- DAC_STB8-	Output	Phase B top CMD or DAC strobe	Programmable function control
91	PWMBBOT8+ DAC8B+	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
92	PWMBBOT8- DAC8B-	Output	Phase B bottom CMD or DAC B serial data	Programmable function control
93	PWMCTOP8+ DIR8+	Output	Phase B top CMD or PFM direction	Programmable function control
94	PWMCTOP8- DIR8-	Output	Phase B top CMD or PFM direction	Programmable function control
95	PWMCBOT8+ PULSE8+	Output	Phase B bottom CMD or PFM pulse	Programmable function control

J12 (JMACH4) Connector Description (Continued)

Pin #	Symbol	Function	Description	Notes
96	PWMCBOT8-PULSE8-	Output	Phase B bottom CMD or PFM pulse	Programmable function control
97	GND	Common	Reference voltage	
98	GND	Common	Reference voltage	
99	+5V	Output/Input	+5V power	For external circuit or from external supply
100	+5V	Output/Input	+5V power	For external circuit or from external supply
The JMACH1 connector provides the interface pins for channels 3 and 4. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board.				

TB1 (2/4-Pin Terminal Block)

This terminal block can be used to provide the input for the power supply for the circuits on the PMAC2 board when it is not in a bus configuration. When the PMAC2 is in a bus configuration, these supplies automatically come through the bus connector from the bus power supply; in this case, this terminal block should not be used.

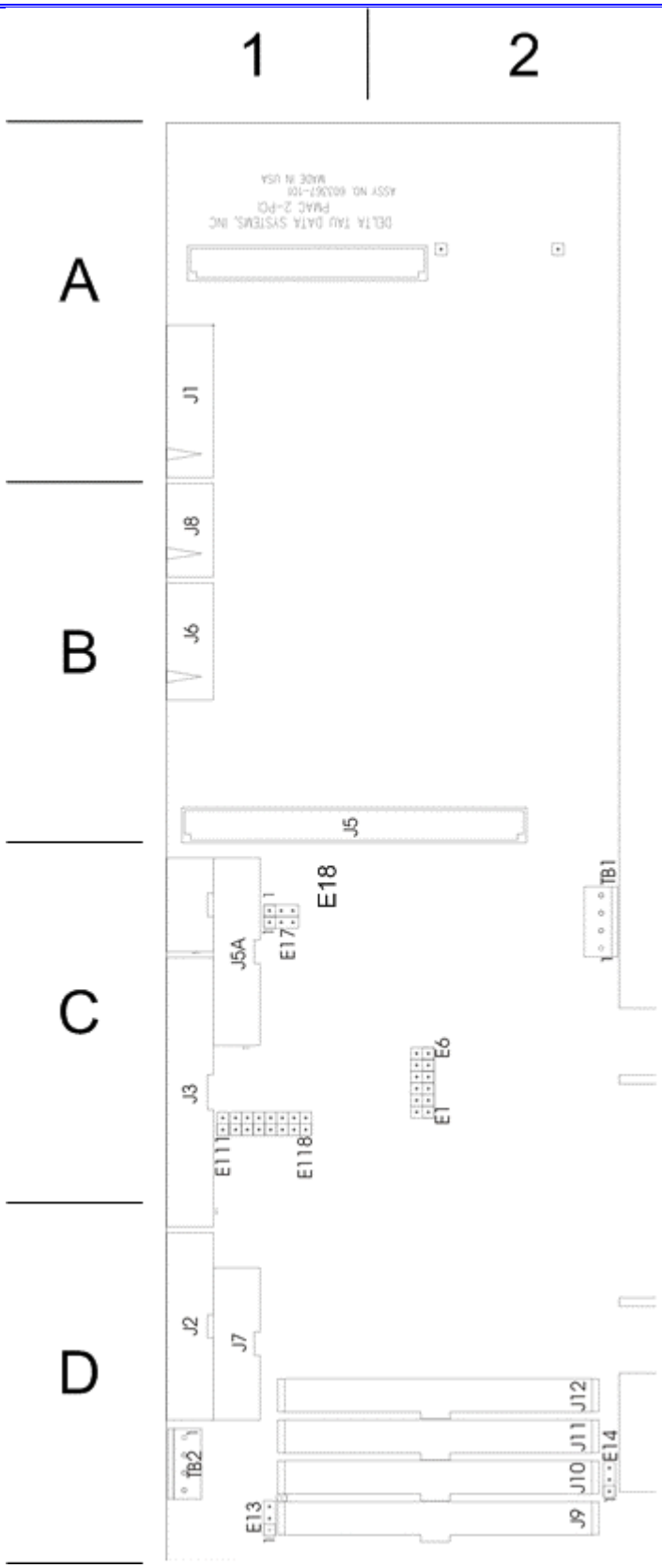
Pin#	Symbol	Function	Description	Notes
1	GND	Common	Reference voltage	
2	+5V	Input	Positive supply voltage	Supplies all PMAC digital circuits
3	+12V	Input	Positive supply voltage	+12V to +15V; not required onboard; used on J1 to supply analog inputs
4	-12V	Input	Negative supply voltage	-12V to -15V; required for Opt-12 ADCs; used on J1 to supply analog inputs
Note: Unless Option 12 (Analog-to-Digital Converters) is included on the board, only pins 1 and 2 will be provided on this terminal block.				

TB2 (3-Pin Terminal Block)

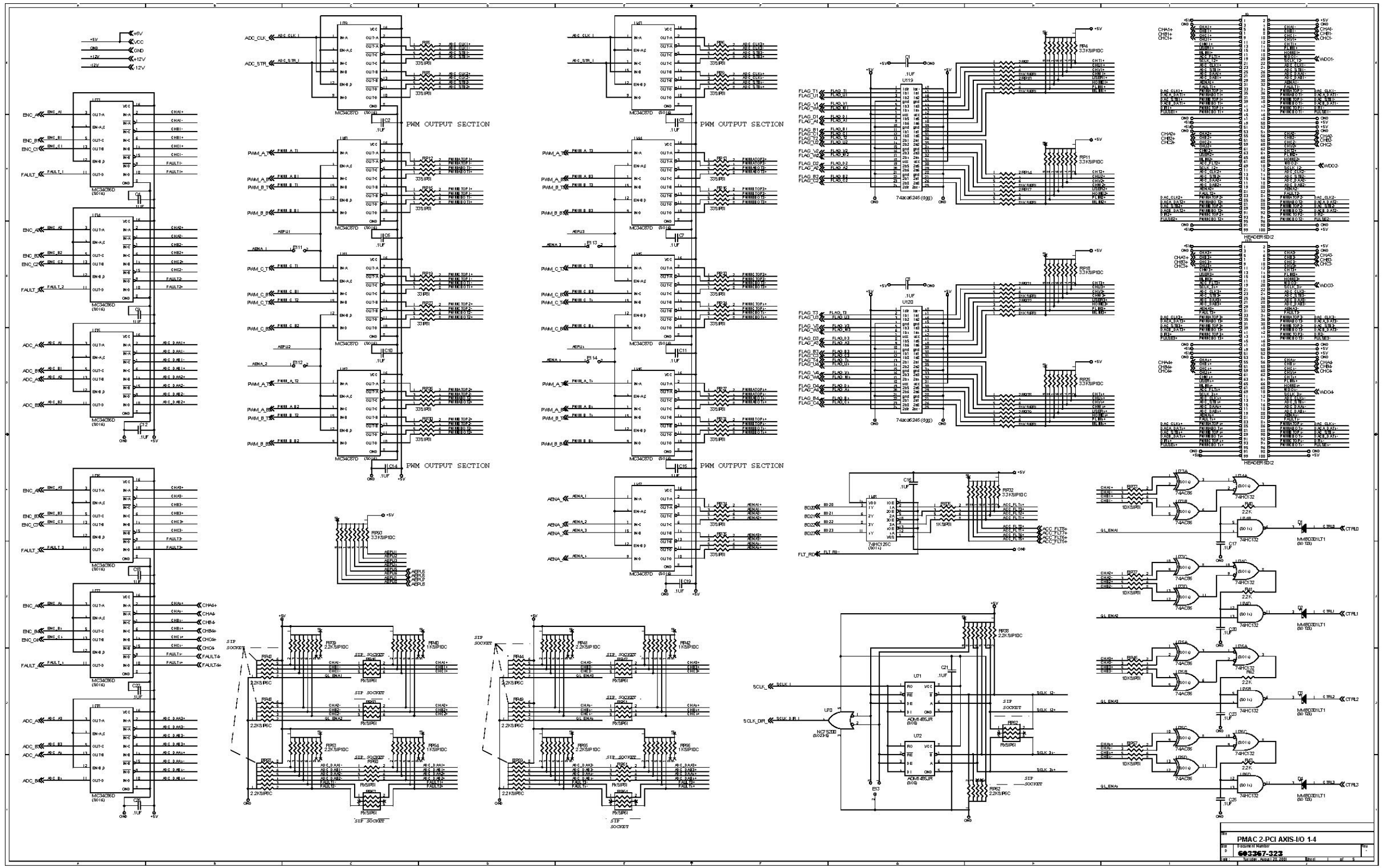
This terminal block provides the output for PMAC2's watchdog timer relay, both normally open and normally closed contacts.

Pin#	Symbol	Function	Description	Notes
1	WD_NC	Output	Watchdog relay out	Normally closed
2	COM	Input	Watchdog return	+V or 0V
3	WD_ No	Output	Watchdog relay out	Normally open
Note: The normally closed relay contact is open while PMAC2 is operating properly – it has power and the watchdog timer is not tripped – and closed when the PMAC2 is not operating properly – either it has lost power or the watchdog timer has tripped. The normally open relay contact is closed while PMAC2 is operating properly and open when PMAC2 is not operating properly.				

BASE BOARD JUMPERS LAYOUT



SCHEMATICS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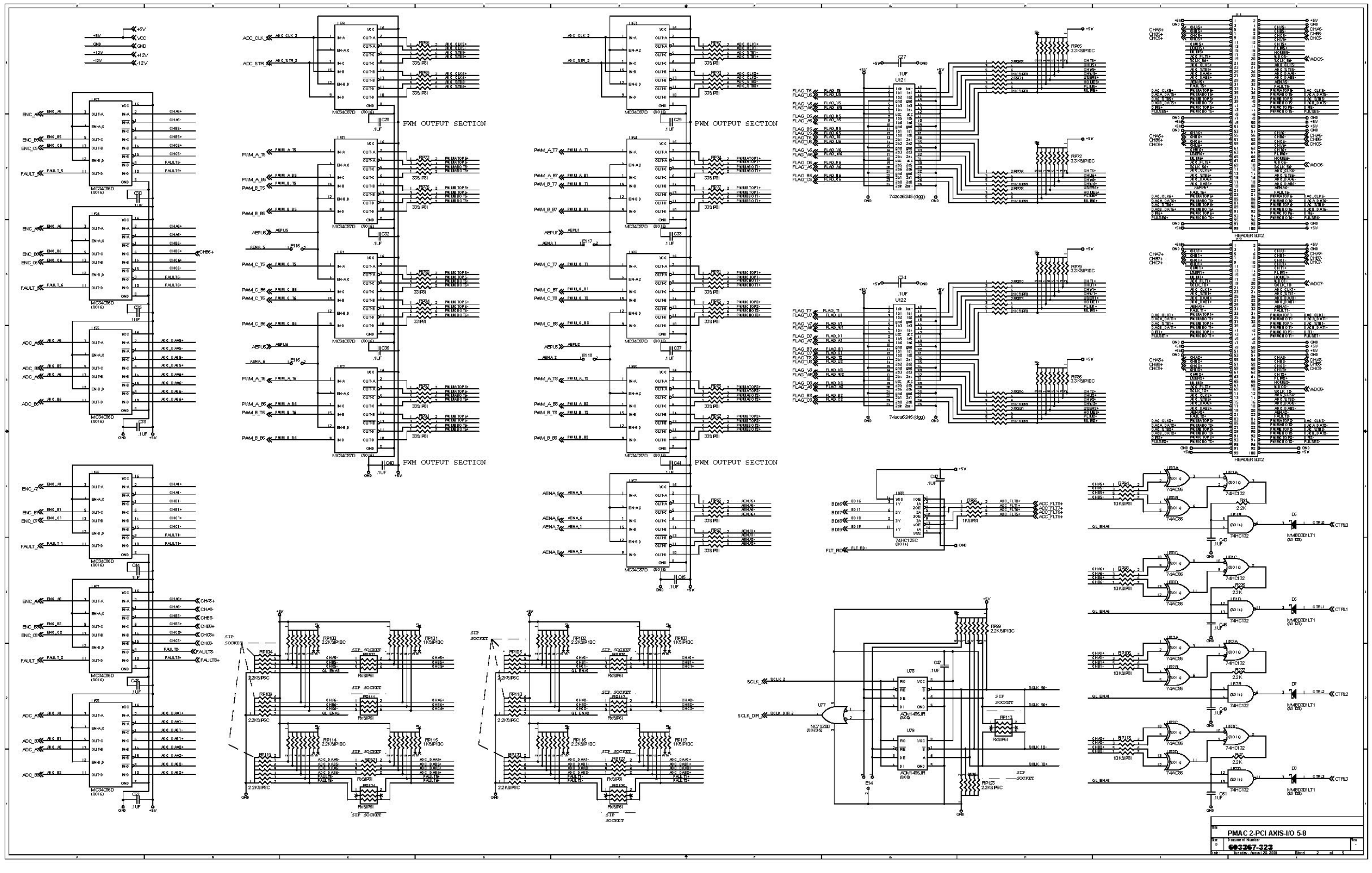
PWM OUTPUT SECTION
PWM OUTPUT SECTION
PWM OUTPUT SECTION
PMAC 2-PCI AXIS-I/O 1-4
603267-323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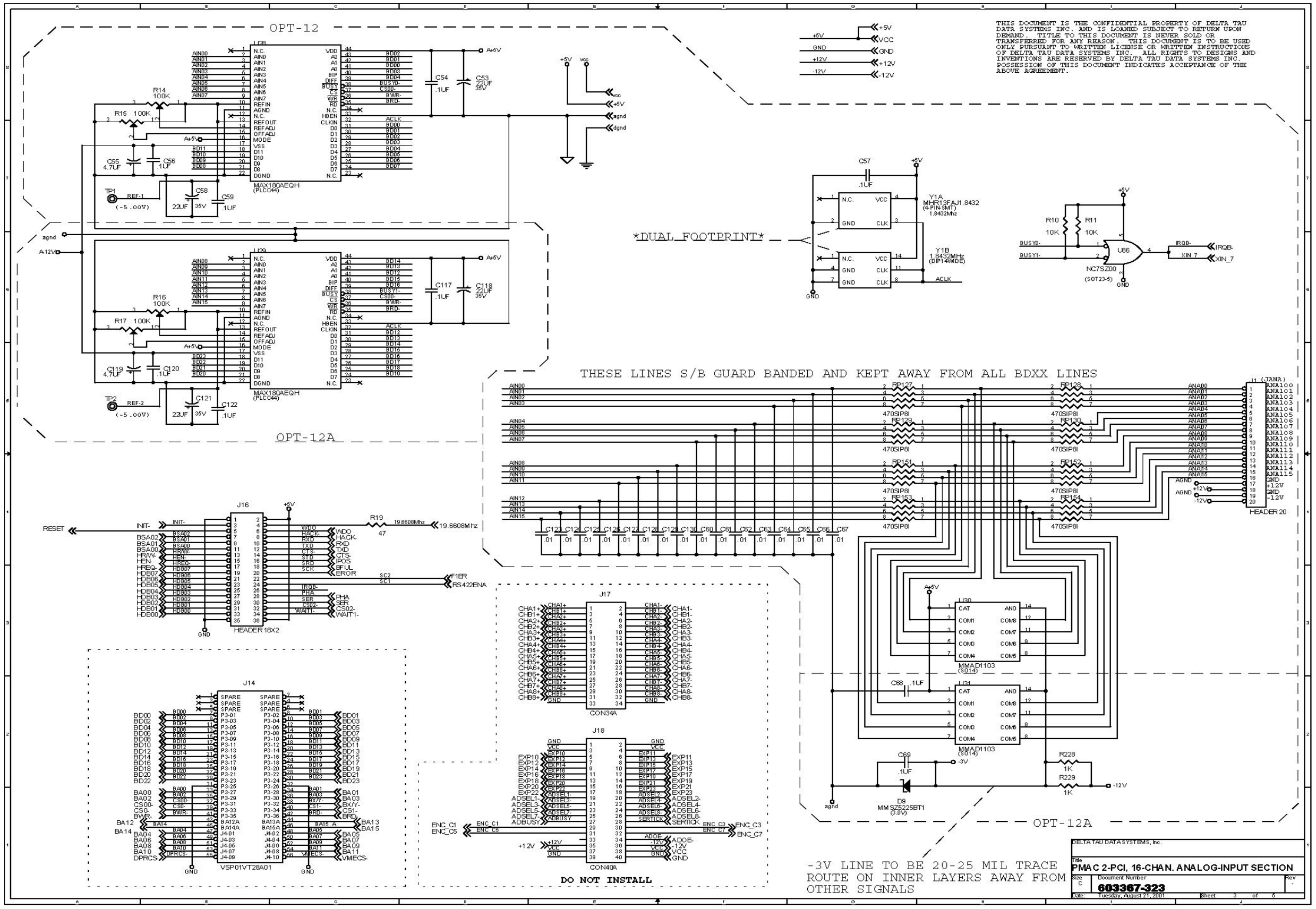
PWM OUTPUT SECTION
PWM OUTPUT SECTION
PMAC 2-PCI AXIS-I/O 5-8
603267-323


OPT-12
OPT-12A
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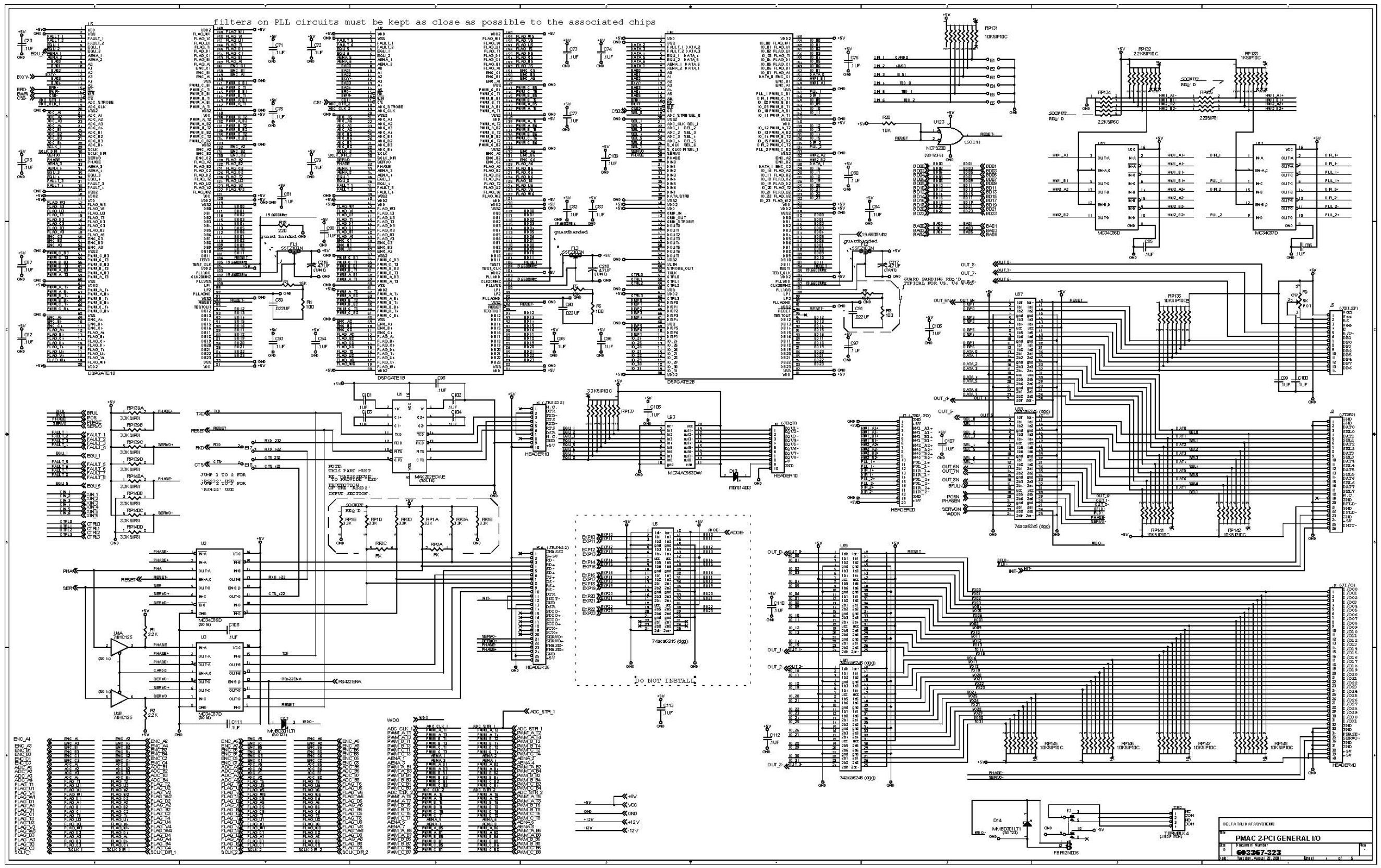
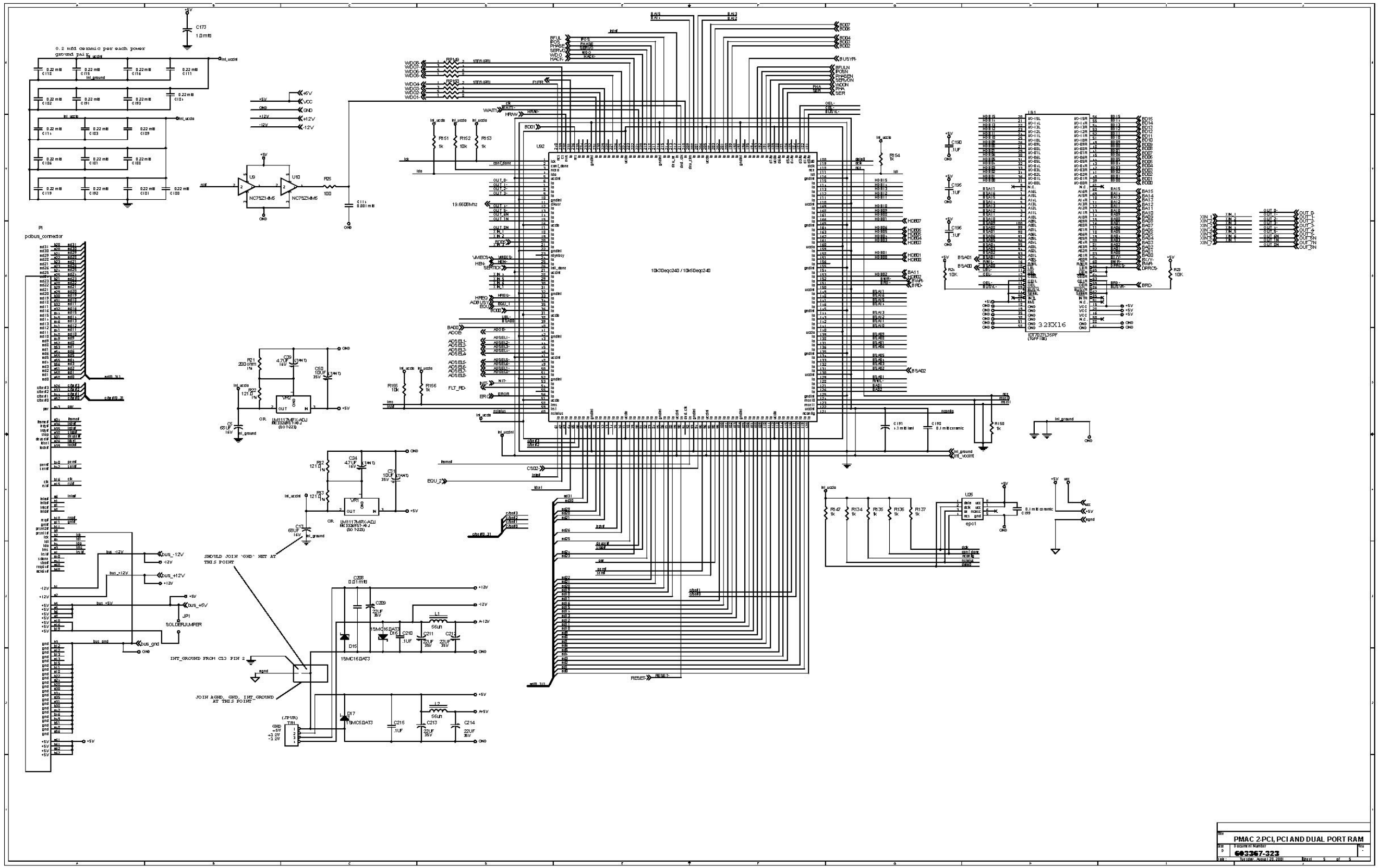
DUAL FOOTPRINT
THESE LINES S/B GUARD BANDED AND KEPT AWAY FROM ALL BDXX LINES
-3V LINE TO BE 20-25 MIL TRACE ROUTE ON INNER LAYERS AWAY FROM OTHER SIGNALS
DO NOT INSTALL
MAX180AEQH (PLCC44)
VSP01VT28A01
HEADER 18X2
HEADER 20
CON34A
CON40A
MMAD1103 (SO14)
NC7SZ00 (SOT23-5)
MMSZ5225BT1 (3.6V)
Y1A MHF13FAJ1.8432 (4-PIN SMT) 1.8432Mhz
Y1B 1.8432MHz (DIP14MDE)
DELTA TAU DATA SYSTEMS, Inc.
PMAC 2-PCI, 16-CHAN. ANALOG-INPUT SECTION
603367-323
Tuesday, August 21, 2001
Sheet 3 of 5


filters on PLL circuits must be kept as close as possible to the associated chips
DSPGATE1B
DSPGATE2B
DO NOT INSTALL
DELTA TAU DATA SYSTEMS
PMAC 2-PCI GENERAL I/O
603367-323


PMAC 2-PCI, PCI AND DUAL PORT RAM
603367-323
10k30eqc240 / 10k50eqc240
19.6608MHz
32KX16
SOLDERJUMPER
JOIN AGND, GND, INT_GROUND AT THIS POINT
SHOULD JOIN 'GND' NET AT THIS POINT
INT_GROUND FROM CN3 PIN 2
15MC16BAT3
15MC5BAT3
epcs1